REMARKS

Entry of this Amendment is proper since it narrows the issues on appeal and does not require further search by the Examiner.

Claims 15-27 and 56-62, 65-76 and 78 are all the claims presently pending in the application. Claims 15, 21, 27 and 62 have been amended to more clearly define the claimed invention. Claims 57, 59, 63-64 and 77 have been canceled.

It is noted that the claim amendments herein are made only for more particularly pointing out the invention, and not for distinguishing the invention over the prior art, narrowing the claims, or for any statutory requirements of patentability.

Further, it is noted that, notwithstanding any claim amendments made herein, Applicant's intent is to encompass equivalents of all claim elements, even if amended herein or later during prosecution.

Specifically, Applicant notes that claims 15, 21 and 27 have been amended to recite "*wherein a lattice constant of said crystalline oxide is substantially a multiple of a lattice constant of silicon*". Applicant notes that this is a novel feature of the claimed invention and points out that on page 2 of the Notice of Allowance dated September 24, 2004 in the parent Application (U. S. Patent No. 09/898,039) of the present Application, the Examiner conceded that the above feature is not taught or suggested by the cited references. Therefore, based on the Examiner's concession in the parent Application, Applicant respectfully submits that all of the claims in the present Application are in condition for immediate allowance.

Claims 21-26, 63-64 and 77 stand rejected under 35 U.S.C. § 112, first paragraph as allegedly failing to comply with the written description requirement.

Claims 15-17, 56, 60, 63, 65, 74 and 76-77 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Morshed ("Epitaxial CeO2 on silicon substrate... for SOI Structures"). Claims 21-23, 27, 58, 61-62, 64, 66-67 and 75 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Morshed in view of Imai et al. (U.S. Patent No. 5,847,419). Claims 20 and 26 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Morshed in view of Imai

further in view of Wang et al. (U. S. Patent No. 6,376,337).

Claims 18-19, 24-25, 68-70 and 78 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Morshed in view of Imai, further in view of Yano et al. (U.S. Patent No. 6,096,434). Claims 71-73 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Morshed in view of Imai, further in view of Ami et al. (U.S. Patent No. 6,610,548).

These rejections are respectfully traversed in view of the following discussion.

I. THE CLAIMED INVENTION

Applicant's invention, as disclosed and claimed (e.g., see independent claim 15 and similarly in claims 21 and 27), is directed to a semiconductor structure which includes a substrate, a crystalline oxide layer including single-crystal oxide formed over the substrate, and a smooth epitaxial silicon layer including single-crystal silicon formed on the crystalline oxide layer. Importantly, a lattice constant of the crystalline oxide is substantially a multiple of a lattice constant of silicon.

Conventional semiconductor structures include epitaxial silicon films formed on CeO_2. However, such structures have resulted in a silicon growth profile that is rough and three dimensional and, moreover, the silicon was not epitaxial in nature (Application at page 3, lines 12-19).

The claimed invention, on the other hand, forms a layer (e.g., a semiconductor layer such as silicon or germanium) on a crystylline oxide, a lattice constant of the crystalline oxide being substantially a multiple of a lattice constant of silicon (Application at page 6, lines 15-20). This helps to allow the claimed invention to provide a smooth epitaxial silicon layer (or epitaxial germanium layer, etc.) formed on a crystalline oxide layer (Application at page 16, lines 14-20). Thus, the claimed invention provides a more uniform and desirable structure than the conventional structure.

II. THE 35 USC 112, FIRST PARAGRAPH REJECTION

The Examiner alleges that claims 21-26, 63-64 and 77 contain subject matter which was

not described in the specification. Applicant submits, however, that these claims are fully enabled by the specification.

Specifically, with respect to claim 21 (incorrectly identified as "claim 27" on page 2 of the Office Action), Applicant notes that the Application clearly discloses "single-crystal germanium". For example, the Application states that "a thin silicon (or other semiconductor) layer" is deposited on an oxide layer, and has "an amorphous microstructure" (Application at page 4, lines 14-17), that the "amorphous silicon (or other semiconductor) /oxide/silicon structure" is heated (Application at page 5, lines 1-3), that the "**amorphous silicon (or other semiconductor) layer transforms to a single crystal epitaxial layer**" (emphasis added) (Application at page 6-8), and that "[t]he present inventors have grown **Ge** and Si by this process on a specific oxide layer" (emphasis added) (Application at page 6, lines 5-6).

Thus, Applicant respectfully submits that it is abundantly clear that the Application discloses "single-crystal Germanium. Applicant would respectfully remind the Examiner that the specification need only be able to enable **one of ordinary skill in the art** to make and use the claimed invention. Certainly, one of ordinary skill in the art could read the Application, including the above passages, and understand that single-crystal germanium is disclosed by the present Application.

Further, claims 63-64 and 77 have been canceled.

Therefore, Applicant respectfully submits that all of the claims are fully enabled by the specification. Therefore, the Examiner is respectfully requested to withdraw this rejection.

III. THE PRIOR ART REFERENCES

A. The Morshed Reference

The Examiner alleges that Morshed teaches the invention of claims 15-17, 56, 60, 63, 65, 74 and 76-77. Applicant submits, however, that there are elements of the claimed invention that are not taught or suggested by Morshed.

Morshed discloses a silicon layer formed on CeO_2. Importantly, the silicon growth profile is rough and three dimensional and, moreover, the silicon is not epitaxial (e.g., not

completely epitaxial) in nature (Morshed at Abstract; Figure 5).

Thus, Morshed does not teach or suggest "*wherein a lattice constant of said crystalline oxide is substantially a multiple of a lattice constant of silicon*", as recited in claims 15, 21 and 27.

As noted above, unlike conventional semiconductor structures which result in a silicon growth profile that is rough and three dimensional and, moreover, the silicon was not epitaxial in nature, the claimed invention forms a layer (e.g., a semiconductor layer such as silicon or germanium) on a crystylline oxide, a lattice constant of the crystalline oxide being substantially a multiple of a lattice constant of silicon (Application at page 6, lines 15-20). This helps to allow the claimed invention to provide a smooth epitaxial silicon layer (or epitaxial germanium layer, etc.) formed on a crystalline oxide layer (Application at page 16, lines 14-20). Thus, the claimed invention provides a more uniform and desirable structure than the conventional structure.

. Clearly, these features are not taught or suggested by Morshed. Indeed, the Examiner alleges that Morshed teaches a lattice mismatch of 0.36% which the Examiner attempts to equate with the claimed invention.

However, Applicant would point out that in the claimed invention, the lattice constant of the crystalline oxide is substantially a multiple of a lattice constant of the silicon. Clearly, a lattice mismatch of 0.36% could not be equated with a lattice constant which is substantially a multiple of a lattice constant of silicon.

Further, the Examiner attempts to rely on Figure 2, the Abstract and page 339 to support her position. However, nowhere in these passages or drawing does Morshed teach or suggest a smooth epitaxial silicon layer including single-crystal silicon formed on the crystalline oxide layer. Certainly, nowhere do these passages or drawing teach or suggest an amorphous layer deposited in the presence of a surfactant vapor, such that the amorphous layer forms a smooth epitaxial silicon layer when annealed.

In fact, Applicant would point out to the Examiner that **Morshed is discussed in the Background section of the present Application** (e.g., see page 3, lines 12-19). Specifically, the Application states that the Morshed structure resulted in a silicon growth profile that is rough and three dimensional. Moreover, unlike the claimed invention, the silicon was not epitaxial

(e.g., completely epitaxial) in nature.

Thus, the present Application clearly recognizes the Morshed paper and clearly sets forth the differences between the rough Morshed structure, and the claimed invention which provides a smooth epitaxial silicon layer. Applicant respectfully submits that the Examiner cannot reasonably ignore the plain language of the Application which clearly distinguishes the Morshed structure from the claimed invention.

Indeed, the Application states that in one exemplary embodiment, the solid phase epitaxy on the oxide surface may be carried out in the presence of a surfactant vapor (Application at page 5, lines 13-20). As a result, the surfactant alters the surface energy of the silicon (or other semiconductor), such that the silicon does not roughen as a result of the solid phase epitaxy.

That is, solid phase epitaxial growth of silicon typically **results in a rough silicon surface** (Application at page 15, lines 5-10). However, when the epitaxy is performed in the presence of a surfactant vapor, **the epitaxial silicon layer has a smooth surface**.

In fact, the formation of a rough surface is illustrated by Morshed. For example, Figure 5 in Morshed clearly illustrates a very rough surface, as described in the Background section of the Application. This is completely different than the claimed invention in which the epitaxial silicon layer may be smooth (e.g., and thin). For example, the smooth epitaxial layer in the claimed structure may have a roughness of less than 5Å (e.g., for an epitaxial silicon layer having a thickness of about 20Å-50Å). Clearly, such a smooth surface of epitaxial silicon is not contemplated by Morshed (e.g., compare Figure 5 of Morshed).

Further, nowhere does Morshed teach or suggest forming an amorphous layer (e.g., of silicon, germanium, etc.) in the presence of a surfactant vapor. Thus, Morshed certainly does not recognize at least one of the methods, that the Application states may be used to form a smooth epitaxial silicon layer.

Further, Applicant would point out that the silicon layer in Morshed is not entirely epitaxial. Indeed, Morshed clearly states that the silicon layer is only "mainly epitaxial" (Morshed at page 342). Figure 2 clearly illustrates that the silicon layer in Morshed is not competely epitaxial, but has large portions which are polycrystalline. That is, the silicon layer is not completely single crystal. Thus, the Morshed structure is completely different than the

claimed structure.

Therefore, Applicant respectfully submits that Morshed does not teach or suggest each and every element of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

B. The Imai Reference

The Examiner alleges that Morshed would have been combined with Imai to form the claimed invention of claims 21-23, 27, 58, 61-62, 64, 66-67 and 75. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Imai discloses a semiconductor device having an n-channel heterojunction field effect transistor (FET) and a p-channel heterojunction field effect transistor (FET) formed on a same substrate (Imai at Abstract).

However, Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, these references are directed to different problems and solutions.

Specifically, Morshed is directed to a method of forming CeO_2 on silicon, whereas Imai is merely directed to n-junction and p-junction FETs on the same substrate. Therefore, these references are completely unrelated, and no person of ordinary skill in the art would have considered combining these disparate references, absent impermissible hindsight.

Further, Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination as alleged by the Examiner. In fact, contrary to the Examiner's allegations, neither of these references teach or suggest their combination. Therefore, Applicant respectfully submits that one of ordinary skill in the art would not have been so motivated to combine the references as alleged by the Examiner. Therefore, the Examiner has failed to make a prima facie case of obviousness.

Moreover, neither Morshed, nor Imai, nor any alleged combination thereof teaches or suggests "*wherein a lattice constant of said crystalline oxide is substantially a multiple of a lattice constant of silicon*", as recited in claims 15, 21 and 27.

As noted above, unlike conventional semiconductor structures, the claimed invention forms a layer (e.g., a semiconductor layer such as silicon or germanium) on a crystylline oxide, and a lattice constant of the crystalline oxide being substantially a multiple of a lattice constant of silicon (Application at page 6, lines 15-20). This helps to allow the claimed invention to provide a smooth epitaxial silicon layer (or epitaxial germanium layer, etc.) formed on a crystalline oxide layer (Application at page 16, lines 14-20). Thus, the claimed invention provides a more uniform and desirable structure than the conventional structure.

Clearly, these features are not taught or suggested by Imai. Indeed, the Examiner is not even relying on Imai as allegedly disclosing this feature.

In fact, the Examiner attempts to equate the oxide layer 14 in Figure 5D in Imai with the crystalline oxide of the claimed invention. However, this is clearly incorrect.

Indeed, Imai merely teaches that the layer 14 is a "thermally oxidized film" which may serve as a gate oxide layer 14 (e.g., see Figure 3K). Imai states that a SiGe layer may be formed on the layer 14, but nowhere does Imai teach or suggest that the lattice constant of the thermal oxide 14 is substantially a multiple of a lattice constant of the silicon. Clearly, the thermal oxide 14 in Imai could not be equated with the crystalline oxide in the claimed invention, which has a lattice constant which is substantially a multiple of a lattice constant of silicon.

Therefore, Imai clearly does not make up for the deficiencies of Morshed.

Therefore, Applicant respectfully submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

C. The Wang Reference

The Examiner alleges that Morshed would have been combined with Imai and that the alleged Morshed/Imai combination would have been further combined with Wang to form the claimed invention of claims 20 and 26. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Wang discloses a method of forming an epitaxial silicon oxide layer between epitaxial silicon (Wang at Abstract).

However, Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, these references are directed to different problems and solutions.

Specifically, in contrast to Morshed and Imai, Wang is is directed to a method of forming a silicon oxide layer. Therefore, Wang is completely unrelated to the other references, and no person of ordinary skill in the art would have considered combining these disparate references, absent impermissible hindsight.

Further, Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination as alleged by the Examiner. In fact, contrary to the Examiner's allegations, neither of these references teach or suggest their combination. Therefore, Applicant respectfully submits that one of ordinary skill in the art would not have been so motivated to combine the references as alleged by the Examiner. Therefore, the Examiner has failed to make a prima facie case of obviousness.

Moreover, neither Morshed, nor Imai, nor Wang, nor any alleged combination thereof teaches or suggests "*wherein a lattice constant of said crystalline oxide is substantially a multiple of a lattice constant of silicon*", as recited in claims 15, 21 and 27.

As noted above, the claimed invention forms a layer (e.g., a semiconductor layer such as silicon or germanium) on a crystylline oxide, and a lattice constant of the crystalline oxide being substantially a multiple of a lattice constant of silicon (Application at page 6, lines 15-20). This helps to allow the claimed invention to provide a smooth epitaxial silicon layer (or epitaxial germanium layer, etc.) formed on a crystalline oxide layer (Application at page 16, lines 14-20). Thus, the claimed invention provides a more uniform and desirable structure than the conventional structure.

Clearly, these features are not taught or suggested by Wang. Indeed, the Examiner does not even rely on Wang as allegedly teaching or suggesting these features. Instead, the Examiner merely cites Wang as allegedly disclosing alternating layers of epitaxial insulator and epitaxial silicon.

In fact, the Examiner attempts to rely on Figure 7 and col 9, lines 49-61 to support her arguments. However, the Examiner is clearly incorrect.

Indeed, Wang merely discloses an insulating layer/barrier formed by combining silicon with one or more elements to form an insulating compound of silicon (Wang at col. 1, lines 10-25). Specifically, Figure 7 merely discloses a silicon oxide layer insulating/interconnect layer. This simple layer is completely unrelated to the crystalline oxide in the claimed invention. Indeed, nowhere does Figure 7 or col. 9 in Wang teach or suggest that the silicon oxide layer in Wang includes a lattice constant which substantially a multiple of a lattice constant of the silicon.

Therefore, Wang does not make up for the deficiencies of the alleged Morshed/Imai combination.

Therefore, Applicant submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

D. The Yano Reference

The Examiner alleges that Morshed would have been combined with Imai and that the alleged Morshed/Imai combination would have been further combined with Yano to form the claimed invention of claims 18-19, 24-25, 68-70 and 78 Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Yano discloses a conductive oxide thin film formed on a substrate having a silicon (100) face at its surface. Specifically, Yano teaches that the conductive oxide thin film may be a zirconate with a rare earth component.

However, Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, these references are directed to different problems and solutions.

Specifically, in contrast to Morshed and Imai, Yano is directed to a method of forming a conductive oxide thin film formed on a substrate. Therefore, Yano is completely unrelated to the other references, and no person of ordinary skill in the art would have considered combining

these disparate references, absent impermissible hindsight.

Further, Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination as alleged by the Examiner. In fact, contrary to the Examiner's allegations, neither of these references teach or suggest their combination. Therefore, Applicant respectfully submits that one of ordinary skill in the art would not have been so motivated to combine the references as alleged by the Examiner. Therefore, the Examiner has failed to make a prima facie case of obviousness.

Moreover, neither Morshed, nor Imai, nor Yano, nor any alleged combination thereof teaches or suggests "*wherein a lattice constant of said crystalline oxide is substantially a multiple of a lattice constant of silicon*", as recited in claims 15, 21 and 27.

As noted above, this feature helps to allow the claimed invention to provide a smooth epitaxial silicon layer (or epitaxial germanium layer, etc.) formed on a crystalline oxide layer (Application at page 16, lines 14-20). Thus, the claimed invention provides a more uniform and desirable structure than the conventional structure.

Clearly, these novel features are not taught or suggested by Yano. Indeed, the Examiner attempts to rely on Yano merely as allogedly teaching an oxide layer including a mixture of rare earth oxides or different rare earth elements.

Moreover, even assuming, arguendo, that Yano discloses such a mixture, Yano clearly does not teach or suggest a crystalline oxide having a lattice constant that is substantially a multiple of a lattice constant of silicon. Specifically, nowhere does Yano teach or suggest that CeO_2 has a a lattice constant that is substantially a multiple of a lattice constant of silicon. Therefore, Yano clearly does not make up for the deficiencies of the alleged Morshed/Imai combination.

Therefore, Applicant respectfully submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

E. The Ami Reference

The Examiner alleges that Morshed would have been combined with Imai and that the alleged Morshed/Imai combination would have been further combined with Ami to form the claimed invention of claims 71-73. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Ami discloses method of forming a ferroelectric non-volatile memory (Ami at Abstract).

However, Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, these references are directed to different problems and solutions.

Further, Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination as alleged by the Examiner. In fact, contrary to the Examiner's allegations, neither of these references teach or suggest their combination. Therefore, Applicant respectfully submits that one of ordinary skill in the art would not have been so motivated to combine the references as alleged by the Examiner. Therefore, the Examiner has failed to make a prima facie case of obviousness.

Thus, neither Morshed, nor Imai, nor Ami, nor any alleged combination thereof teaches or suggests "*wherein a lattice constant of said crystalline oxide is substantially a multiple of a lattice constant of silicon*", as recited in claims 15, 21 and 27.

Clearly, these novel features are not taught or suggested by Ami. Indeed, the Examiner attempts to rely on Ami merely as allegedly teaching an oxide layer that crystallizes to have a bixbyite structure.

However, even assuming, arguendo, that Ami discloses such an oxide, Ami clearly does not teach or suggest that the oxide has a lattice constant of that is substantially a multiple of a lattice constant of silicon. Indeed, Ami merely discloses films such as CeO_2 films (Ami at col. 4, lines 3-58) and Y_2O_3 films (Ami at col. 4, lines 59-64) (As an aside, Applicant notes that Ami states that "it has not been reported at all that CeO2 (001) could be epitaxially grown directly on a Si (001) substrate").

However, nowhere does Ami teach or suggest that either of the CeO_2 films or Y_2O_3 films

has a lattice constant of that is substantially a multiple of a lattice constant of silicon. Therefore, Ami is clearly unrelated to the claimed invention and fails to make up for the deficiencies of the alleged Morshed/Imai combination.

Therefore, Applicant respectfully submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

III. FORMAL MATTERS AND CONCLUSION

In view of the foregoing, Applicant submits that claims 15-27 and 56-62, 65-76 and 78 , all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Assignee's Deposit Account No. 50-0510.

Date: 1/11/05

Respectfully Submitted,

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